



(11) Publication number: **0 488 552 A2**

## EUROPEAN PATENT APPLICATION

(21) Application number: **91310488.1**

(51) Int. Cl.<sup>5</sup>: **A61G 7/005**

(22) Date of filing: **13.11.91**

(30) Priority: **28.11.90 GB 9025897**  
**06.04.91 GB 9107277**

(43) Date of publication of application:  
**03.06.92 Bulletin 92/23**

(54) Designated Contracting States:  
**AT BE CH DE DK ES FR GB GR IT LI LU NL SE**

(71) Applicant: **J. NESBIT EVANS & COMPANY LIMITED**  
 Unit 8, Woodbank Trading Estate, Woden  
 Road West  
 Wednesbury, West Midlands WS10 7BL(GB)

(72) Inventor: **Hayes, Stephen**  
 46 Wallows Wood, The Straits  
 Lower Gornal, Dudley, West Midlands(GB)  
 Inventor: **Jones, Robert Hugh**  
 9 Olga Drive, Burberry Grange  
 Tipton, West Midlands(GB)

(74) Representative: **Hands, Horace Geoffrey et al**  
**LEWIS W. GOOLD & CO. Whitehall Chambers**  
 23, Colmore Row  
 Birmingham B3 2BL(GB)

(54) Beds.

(57) A tiltable bed, Figure 2, has the tilt adjusted by two actuators 60, 62, which can also be used to raise and lower the mattress frame 40. A level sensor 80 is connected to the actuators so that if the tilt

varies from the adjusted and desired position, the electric current to one or other actuator is adjusted to restore the desired position.

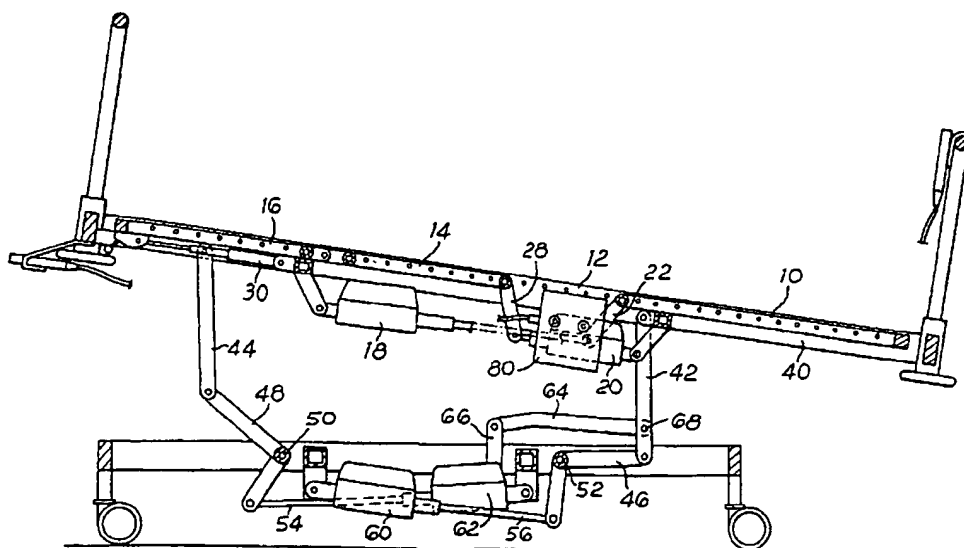


Fig. 2

EP 0 488 552 A2

This invention relates to beds, patient trolleys and like person supports (herein called beds) of the kind comprising a frame or platform (herein called platform) to carry the person - usually with a mattress interposed - and with means for varying the height of said platform.

One design, to which this invention relates, but without limitation thereto, comprises a wheeled chassis with two fixed parallel transversely extending pivot shafts. A pair of bell cranks is supported on each shaft. One end of each crank is hinged to the underside of said platform. The other ends of the cranks are coupled together and an actuator is connected between them so as to turn the cranks in unison. This brings about the raising or lowering. An example of such a bed is to be found in Patent EP 0 095 538 A. In said patent, the actuator is a mechanical jack.

It is also known to use an electrical actuator instead of the jack, for example an electric motor driving a screw and nut mechanism or the like. This has the advantage of requiring minimal effort by the operator, to press a button instead of for example foot operation of a lever on a mechanical jack.

Such a bed can be tilted, as is required for certain medical procedures by mounting the mattress frame on a pivot at one end and with an adjustable position link and catch means at the other end. To tilt, the catch is released, the mattress is adjusted for example against or by a gas spring, and the catch re-engaged.

The object of the invention is to provide an improved bed.

According to the invention a bed is characterised by the provision of separate power operated actuators, one for the head end and one for the foot end of the bed, and a level sensor connected to both actuators and arranged to maintain the angle of the platform relative to the sensor by adjusting power supply to the respective actuators.

The level sensor has the important effect of enabling the normal angle of the bed (for example but without limitation, level or zero) to be maintained even if the bed is unequally loaded. If someone sits on one end of the bed when it is to be raised, the actuator at that end has a greater load and without the level sensor the bed would assume unwanted tilt.

Preferably the actuators are low voltage and preferably reversible electric motors, for example 24 volts, so as to enable the bed to be battery powered at least when being moved from place to place, for example between a hospital ward and an operating theatre.

The power adjustment may be voltage variation.

Whilst it would be within the scope of the

invention to adjust tilt by reducing power to one actuator whilst maintaining full power on the other, it is preferred to drive the actuators oppositely for this purpose. The precise details of this will depend upon layout. However, if both actuators are driven in the same direction to bring about lift or lower without (intentional) tilt variation, then one is reversed to bring about a required tilt variation. If one actuator reaches the end of its stroke before the desired variation is attained, then the other carries on until it is completed. This e.g. avoids the mattress 'fouling' on other components.

According to a feature of the invention the level sensor is settable to enable the level to be adjusted. Hence it can be set horizontal, that is for a condition of the mattress platform parallel to level ground or 0 deg., or at any desired angle thereto. Hence, a desired tilt may be brought about by changing the position of the setting. The sensor then powers the actuators to move the platform until its angle coincides with the setting. This feature also enables rapid resetting of angle, for example restoration of a level condition simply by resetting the sensor.

The level sensor could be a switch mounted on the movable and tiltable part so that it can be set parallel to the part or at any angle thereto: the circuitry will cause the motors to adjust tilt until it is again horizontal. Alternatively the same effect may be attained by position indicators, which are to be considered as level sensors within the meaning of the words used in this specification. Thus, a rotary potentiometer may be used in a pivot to give a variable resistance which is an analogue of the angular position, or the actuator may have a rod which is displaced by the movement, and the measurement of the displacement can be used as an indication of the adjustment, and via a memory of the level attained.

Preferably the level sensor is mounted on the mattress frame in a position inaccessible to the patient, for example on the side of the mattress support near the foot of the bed, or below the mattress generally centrally.

The circuitry may be associated with a hand control for example one having one switch or push-button which can be pressed to operate both actuators to bring about elevation of the mattress platform, and another which can be similarly actuated to bring about normal lowering.

One presently preferred embodiment of the invention is now more particularly described with reference to the accompanying drawings wherein :-

Figures 1 - 3 are side elevations of a bed in three different positions;

Figure 4 is a sectional plan view taken on the line 4-4 of Figure 1, and

Figure 5 shows a handset controller.

Referring to the drawings, the bed shown therein may have a profiling action as shown in Figure 1 in which successive mattress support portions 10, 12, 14 and 16 are hinged or profiled to form a backrest, buttock support, thighrest and legrest respectively. This movement is achieved by the use of a pair of actuators 18 20, the first of which (18) is connected to crank 22 by rod 24 (shown broken away in Figure 1 for the purposes of clarity) and the second of which (20) is similarly connected by rod 26 to crank 28. The arrangement may be such that when the backrest portion 10 is steepened in angle, the thighrest 14 is steepened but at a proportionally lower rate, and legrest 16 is pivoted to the thighrest 14. A telescopically adjustable strut 30 with a catch 32 for release from a lock position enables the legrest to be moved to the horizontal position shown in chain dot line at 34 or any other position as required for patient care.

Figures 2 and 3 show the profiling section moved to co-planar condition. These mattress support sections are mounted on a common framework 40 which is freely pivoted to upwardly extending struts 42 44 which in turn are pivoted to cranks 46 48 pivoted on cross shafts 50 52 and connected respectively to the rods 54 56 of a further pair of actuators 60 62. A control link 64 is pivoted between a fixed bracket 66 and a point 68 on the link 42 to maintain link 42 in a generally vertical position during movement of the crank 46 in lifting or lowering that link 42.

The actuators 60 62 are low voltage motors which drive their respective rods 54 56 through a recirculating ball nut device, but actuators of this kind are freely available from a number of sources and require no further description to those skilled in the art.

The mattress frame 40 may be lifted and lowered and adjusted in tilt or maintained at a required angle by control means. The control means may include a handset such as that shown in Figure 5 having a button 70 which is pressed to supply current to both actuators 60 62 so as to lift the mattress frame. A further button 72 is pressed to lower the mattress frame by supplying current of the opposite polarity to both actuators. A further pair of buttons 74 76 is provided for causing increase in tilt relative to the horizontal in one direction for example to raise the footrest end of the bed, and the other button 76 for causing the opposite movement to raise the head end of the bed.

A typical control mechanism within the scope of the invention may be mounted in a control box 80 and comprise a pendulum-like member freely pivoted to hang in a vertical position, whilst the control box includes read-heads of sensors mounted on the box and which thus move relative to the pendulum if the angle of inclination of the mattress

changes. The pendulum may carry graduations which cause signals in the sensor or read-heads in one or other direction according to whether the angle is changing in a positive or negative sense i.e. clockwise or anticlockwise movement, and the handset may include a readout 82 giving an indication of the actual angle of the mattress frame relative to the horizontal or zero.

The control system operates so that if either a button 70 or 72 is pressed, the same voltage is fed to both actuators 60 62 in the sense to cause lifting or lowering as the case may be but without intentional adjustment of angle. If the angle shifts during that lifting or lowering, for example because the mattress frame is unequally loaded, and one example of this would be due to someone sitting on one end of the bed or some heavy equipment such as oxygen cylinders is on one end of the bed, then the one motor will have a greater load than the other and the angle of tilt will change. This will cause the read-heads to move relative to the pendulum, control signals to be generated, and, as a result of a microprocessor action, this will bring about an adjustment of the current supply to one or other of the motors in the sense which will bring about a restoration of the angle.

The handset may include a further control button 88 used under 'crash' conditions when it is required to restore the bed to a level condition and possibly also to a minimum height as quickly as possible, and the purpose of this is to bring circuitry into play to cause such operation of the actuators 60 and 62 as is necessary for this purpose without the operatives such as nurses having to consider which of the other buttons needs to be pressed for that purpose.

Preferably the circuitry also includes an inherent delay of the order of say 2 or 3 seconds which comes into operation whenever the mattress frame is being tilted and it reaches a condition of zero tilt. This facilitates levelling of the bed without the risk of overshooting.

In summary, a first possibility for positional control is the described pendulum or like arrangement which moves with the mattress, and causes a signal which can be stored in memory and/or compared with a memory setting so as to cause variation in the power supply to one or other or both actuators so as to restore a required angle of tilt or bring about a required angle of tilt; a second possibility is to sense the angle of a part of the bed relative to a pivot axis, for example the angle of the part 40 or the angle of one of the cranks. This can likewise be used in the same way to bring about adjustment. A third possibility is to use the position of the rods 54 56, that is to say the extension of these relative to the actuators for like purposes. This can be done for example by a mechanical

drive between the rod and a control device such as a rack and pinion drive, or by providing graduations or indicia on the rods which are effective on read-heads in generally the same way described in relation to the pendulum: the advantage in the case of using the rods is the relatively large movement taking place between the minimum and maximum positions of the rod and hence the possibility of accurate and fine adjustment.

5

10

### Claims

1. A bed comprising a frame or platform and means for varying the height of the platform characterised by the provision of separate power operated actuators, one for the head end and one for the foot end of the bed, and a level sensor connected to both actuators and arranged to maintain the angle of the platform relative to the sensor by adjusting power supply to the respective actuators. 15 20
2. A bed as claimed in Claim 1 wherein the actuators are low voltage reversible electric motors. 25
3. A bed as claimed in Claim 2 wherein power adjustment is by way of voltage variation.
4. A bed as claimed in any preceding claim wherein the actuators are arranged to be driven in opposite directions in order to adjust the angle of tilt. 30
5. A bed as claimed in any preceding claim wherein the level sensor is settable to enable the level to be adjusted. 35
6. A bed as claimed in any preceding claim wherein the level sensor comprises a pendulum mounted on the tiltable part of the bed sensors which move during angular adjustment relative to the pendulum. 40
7. A bed as claimed in any preceding claim wherein at least one actuator is provided with a rod which extends relative to the actuator and is displaced during adjustment of position of the bed by that actuator, and said displacement of the rod is used to provide a control signal and compared with the memory for causing continuation or termination of the adjustment as the case 45 50
8. A bed substantially as hereinbefore described and with reference to the accompanying drawings. 55

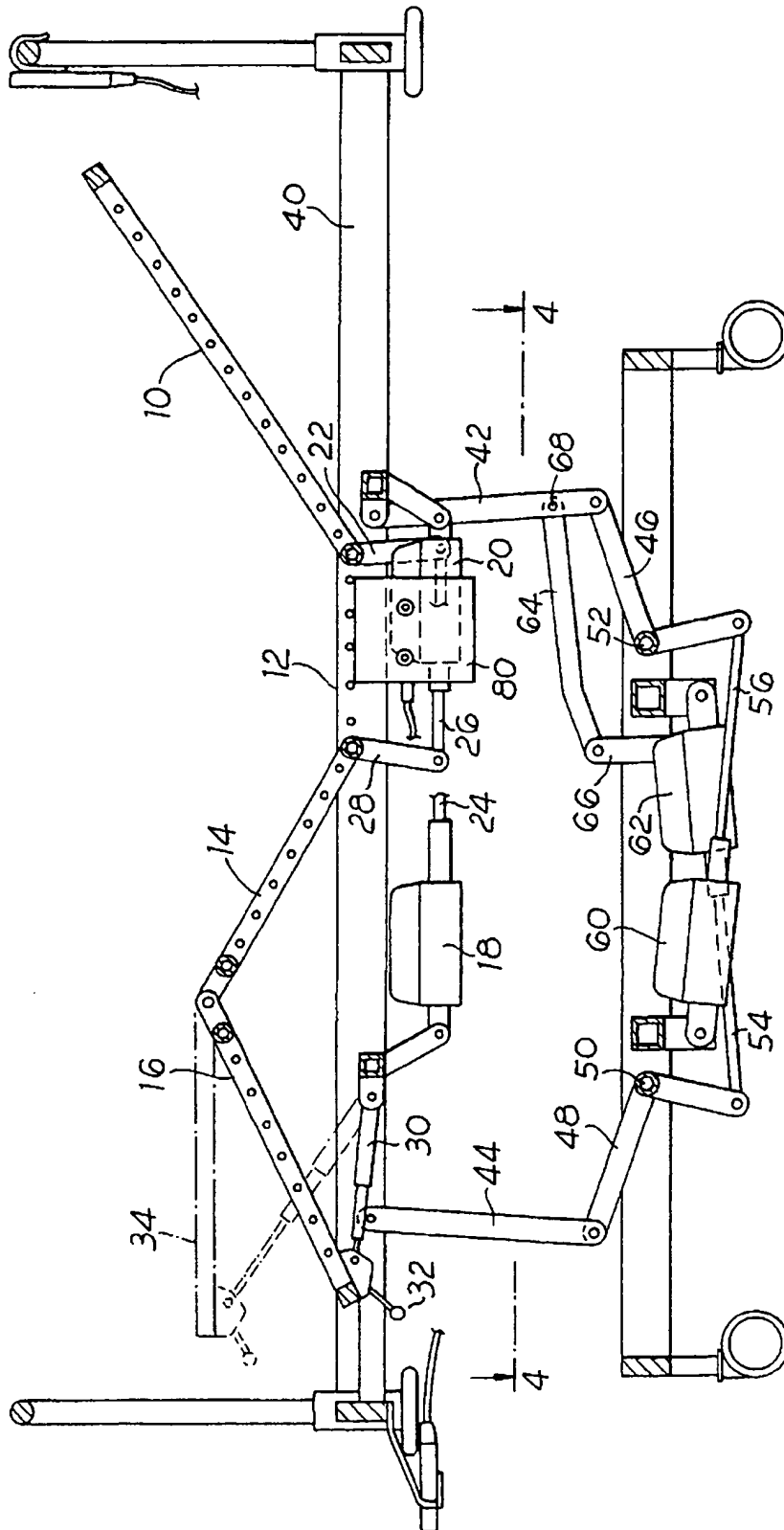


Fig. 1

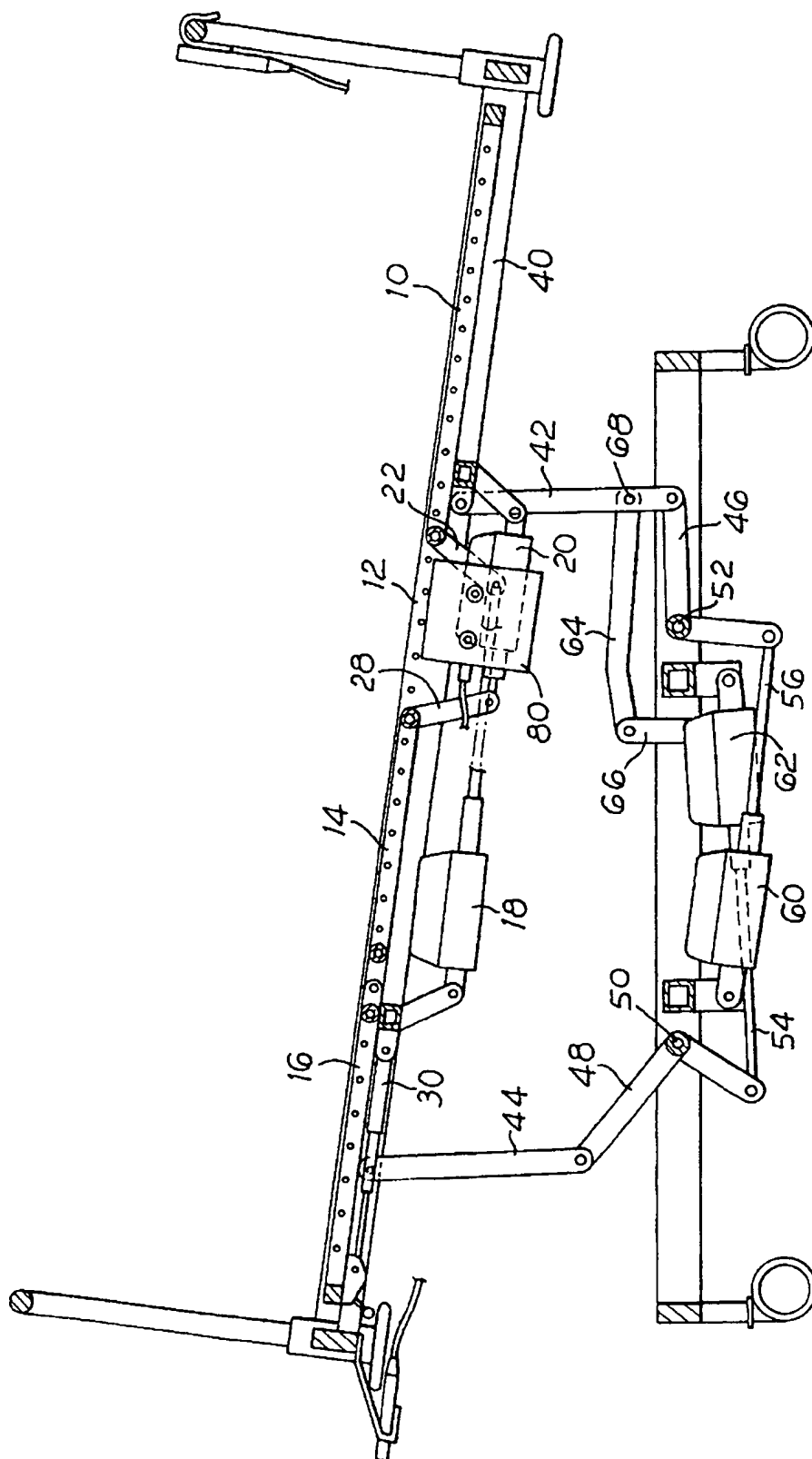


Fig. 2

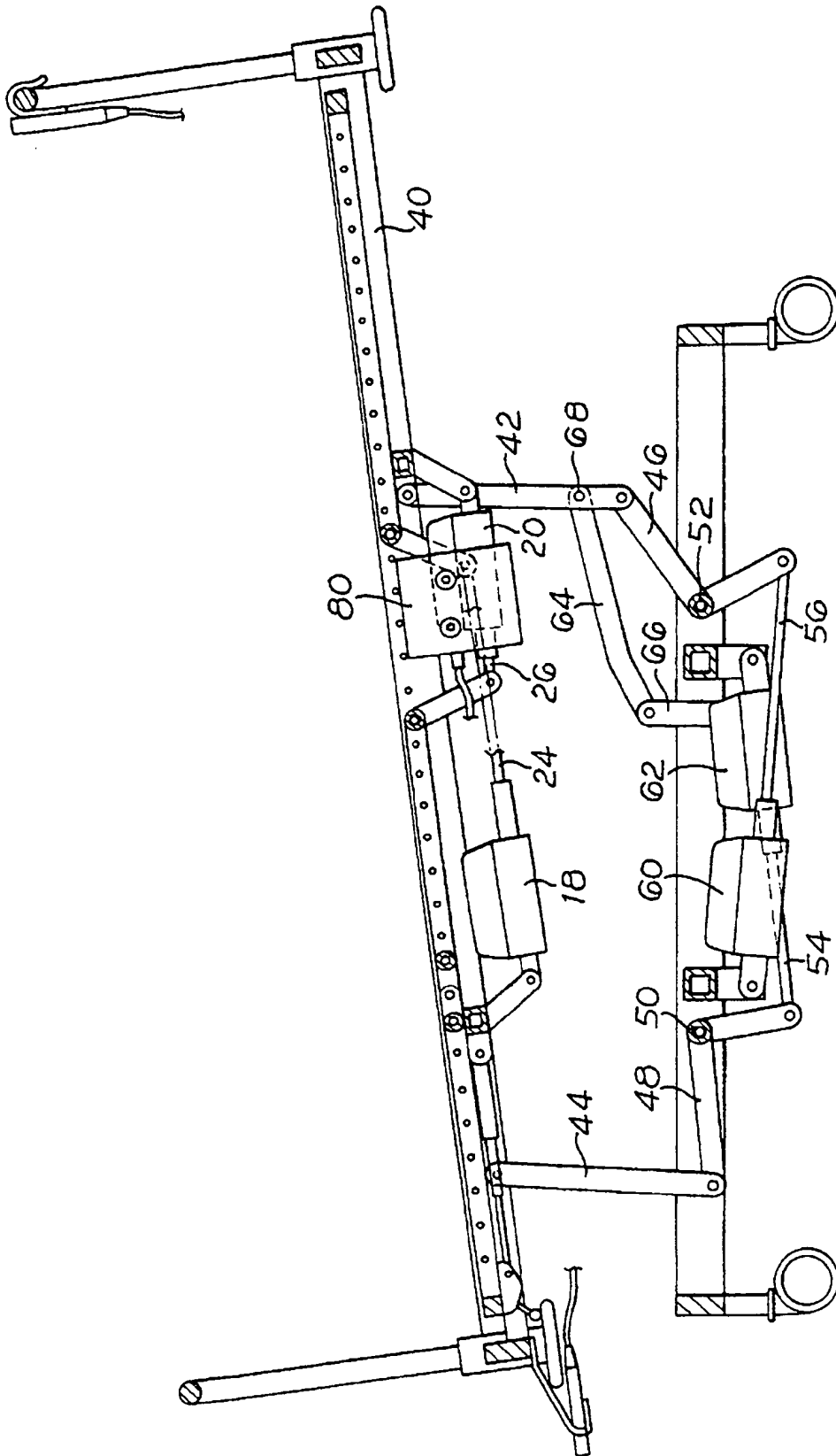


Fig. 3

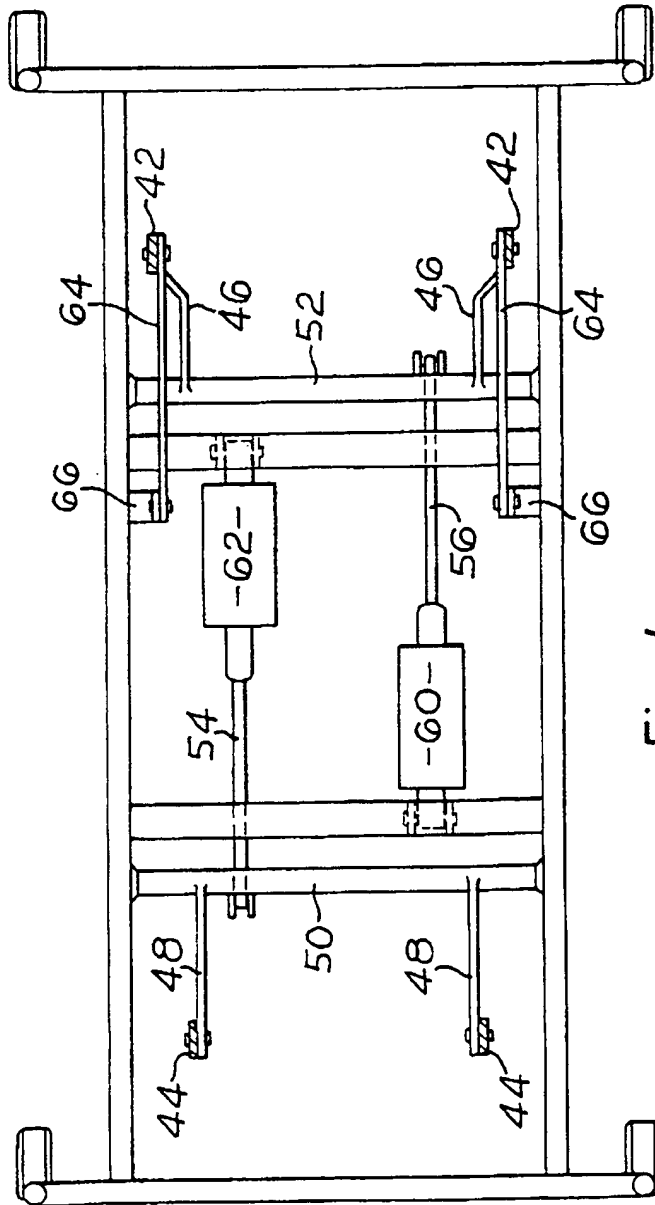


Fig. 4

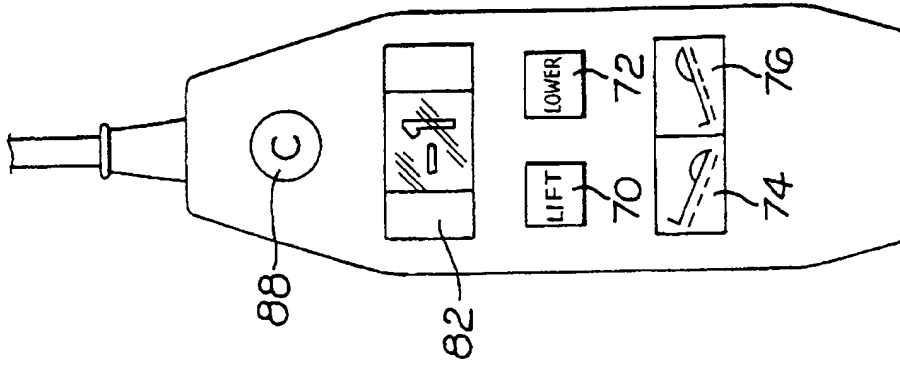


Fig. 5





Europäisches Patentamt  
European Patent Office  
Office européen des brevets



Publication number:

**0 488 552 A3**

12

## EUROPEAN PATENT APPLICATION

21 Application number: **91310488.1**

51 Int. Cl.<sup>5</sup>: **A61G 7/005**

22 Date of filing: **13.11.91**

30 Priority: **28.11.90 GB 9025897**  
**06.04.91 GB 9107277**

43 Date of publication of application:  
**03.06.92 Bulletin 92/23**

84 Designated Contracting States:  
**AT BE CH DE DK ES FR GB GR IT LI LU NL SE**

88 Date of deferred publication of the search report:  
**09.09.92 Bulletin 92/37**

71 Applicant: **J. NESBIT EVANS & COMPANY LIMITED**  
**Unit 8, Woodsbank Trading Estate, Woden Road West**  
**Wednesbury, West Midlands WS10 7BL(GB)**

72 Inventor: **Hayes, Stephen**  
**46 Wallows Wood, The Stralts Lower Gornal, Dudley, West Midlands(GB)**  
Inventor: **Jones, Robert Hugh**  
**9 Olga Drive, Burberry Grange Tipton, West Midlands(GB)**

74 Representative: **Hands, Horace Geoffrey et al LEWIS W. GOOLD & CO. Whitehall Chambers**  
**23, Colmore Row Birmingham B3 2BL(GB)**

51 **Beds.**

57 A tiltable bed has the tilt adjusted by two actuators (60,62), which can also be used to raise and lower the mattress frame (40). A level sensor (80) is connected to the actuators (60,62) so that if the tilt

varies from the adjusted and desired position, the electric current to one or other actuator (60,62) is adjusted to restore the desired position.

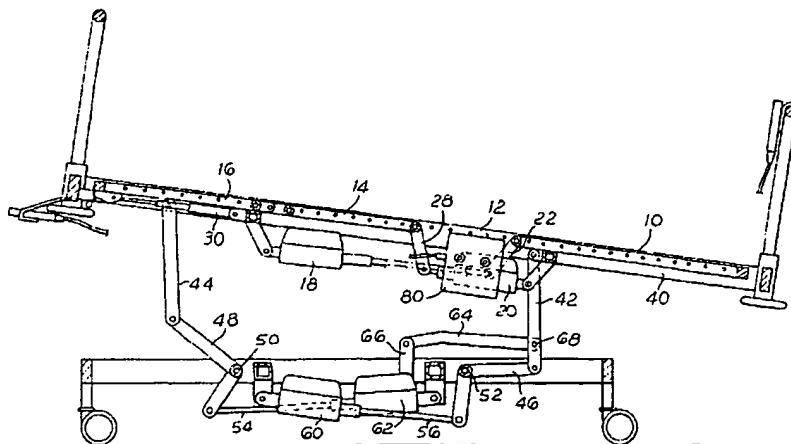


Fig. 2

EP 0 488 552 A3



European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number

EP 91 31 0488

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-4 769 584 (IRIGOYEN) * the whole document *	1, 2, 4, 5	A61G7/005
A	US-A-3 402 408 (HUTT) * claim 1; figures *	1	
A, D	EP-A-0 095 538 (J. NESBIT-EVANS & COMPANY LTD.) * abstract; figures *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			A61G A47C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 02 JULY 1992	Examiner BAERT F.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPF FORM 1503 (01.87) (P0401)

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**